第七节:Spring Aop源码分析

一:AOP

1.1)AOP

AOP（Aspect Oriented Programming），即面向切面编程，可以说是OOP（Object Oriented Programming，面向对象编程）的补充和完善。**OOP引入封装、继承、多态等概念来建立一种对象层次结构**，用于模拟公共行为的一个集合。不过OOP允许开发者定义纵向的关系，但并不适合定义横向的关系，例如日志功能。日志代码往往横向地散布在所有对象层次中，而与它对应的对象的核心功能毫无关系对于其他类型的代码，如安全性、异常处理和透明的持续性也都是如此，这种散布在各处的无关的代码被称为横切（cross cutting），在OOP设计中，它导致了大量代码的重复，而不利于各个模块的重用。

AOP技术恰恰相反，它利用一种称为"横切"的技术，剖解开封装的对象内部，并将那些影响了多个类的公共行为封装到一个可重用模块，并将其命名为"Aspect"，即切面。所谓"切面"，简单说就是那些与业务无关，却为业务模块所共同调用的逻辑或责任封装起来，便于减少系统的重复代码，降低模块之间的耦合度，并有利于未来的可操作性和可维护性。

使用"横切"技术，AOP把软件系统分为两个部分：**核心关注点和横切关注点**。业务处理的主要流程是核心关注点，与之关系不大的部分是横切关注点。横切关注点的一个特点是，他们经常发生在核心关注点的多处，而各处基本相似，**比如权限认证、日志、事物。AOP的作用在于分离系统中的各种关注点，将核心关注点和横切关注点分离开来**。

1.2)基本概念

AOP核心概念

1、横切关注点(对哪些方法进行切入)

对哪些方法进行拦截，拦截后怎么处理，这些关注点称之为横切关注点

2、切面（aspect,把原来糅杂在业务逻辑代码中的非业务代码抽取出来，把功能相同的放在一个类中形成一个切面）

类是对物体特征的抽象，切面就是对横切关注点的抽象

3、连接点（joinpoint）（需要切入的点）

被拦截到的点，因为Spring只支持方法类型的连接点，所以在Spring中连接点指的就是被拦截到的方法，实际上连接点还可以是字段或者构造器

4、切入点（pointcut）

对连接点进行拦截的定义

5、通知（advice）

所谓通知指的就是指拦截到连接点之后要执行的代码，通知分为前置、后置、异常、最终、环绕通知五类

6、目标对象

代理的目标对象

7、织入（weave）

将切面应用到目标对象并导致代理对象创建的过程

8、引入（introduction）

在不修改代码的前提下，引入可以在运行期为类动态地添加一些方法或字段

1.3）简单案例:

```
public interface Calculate {

    /**
     * 加法
     * @param numA
     * @param numB
     * @return
     */
     int add(int numA,int numB);

    /**
     * 减法
     * @param numA
     * @param numB
     * @return
     */
     int reduce(int numA,int numB);

    /**
     * 除法
     * @param numA
     * @param numB
     * @return
     */
     int div(int numA,int numB);

    /**
     * 乘法
     * @param numA
     * @param numB
     * @return
     */
     int multi(int numA,int numB);
}

=====================实现类
public class TulingCalculate implements Calculate {

    public int add(int numA, int numB) {

        return numA+numB;
    }
    public int reduce(int numA, int numB) {
        return numA-numB;
    }

    public int div(int numA, int numB) {
        return numA/numB;
    }

    public int multi(int numA, int numB) {
        return numA*numB;
    }
}

=====================切面类=====================
@Aspect
public class TulingLogAspect {

    @Pointcut("execution(* com.tuling.TulingCalculate.*(..))")
    public void pointCut(){};

    @Before(value = "pointCut()")
    public void methodBefore(JoinPoint joinPoint){
        String methodName = joinPoint.getSignature().getName();
        System.out.println("执行目标方法【"+methodName+"】之前执行<前置通知>,入参"+ Arrays.asList(joinPoint.getArgs()));
    }

    @After(value = "pointCut()")
    public void methodAfter(JoinPoint joinPoint) {
        String methodName = joinPoint.getSignature().getName();
        System.out.println("执行目标方法【"+methodName+"】之前执行<后置通知>,入参"+Arrays.asList(joinPoint.getArgs()));
    }

    @AfterReturning(value = "pointCut()")
    public void methodReturning(JoinPoint joinPoint ) {
        String methodName = joinPoint.getSignature().getName();
        System.out.println("执行目标方法【"+methodName+"】之前执行<返回通知>,入参"+Arrays.asList(joinPoint.getArgs()));
    }

    @AfterThrowing(value = "pointCut()")
    public void methodAfterThrowing(JoinPoint joinPoint) {
        String methodName = joinPoint.getSignature().getName();
        System.out.println("执行目标方法【"+methodName+"】之前执行<异常通知>,入参"+Arrays.asList(joinPoint.getArgs()));
    }
}

===========================配置类=============
@Configuration
@EnableAspectJAutoProxy
public class MainConfig {

    @Bean
    public Calculate calculate() {
        return new TulingCalculate();
    }

    @Bean
    public TulingLogAspect tulingLogAspect() {
        return new TulingLogAspect();
    }
}
```

2）我们看到在我们配置类上加入了@EnableAspectJAutoProxy这个东东？我们着重来分析一下这个东东给我容器中添加了什么组件?

2.1)我们发现@EnableAspectJAutoProxy上标注了一个@Import注解，通过前面的学习我们知道@Import可以给我们容器中添加组件

```
@Target(ElementType.TYPE)
@Retention(RetentionPolicy.RUNTIME)
@Documented
@Import(AspectJAutoProxyRegistrar.class)
public @interface EnableAspectJAutoProxy {
```

2.2)所有我们来分析AspectJAutoProxyRegistrar类是用来干什么的?

经过跟踪源代码我们发现,AspectJAutoProxyRegistrar实现了ImportBeanDefinitionRegistrar接口，我们以前学习过

凡是实现了ImportBeanDefinitionRegistrar可以给我们容器中添加bean定义信息

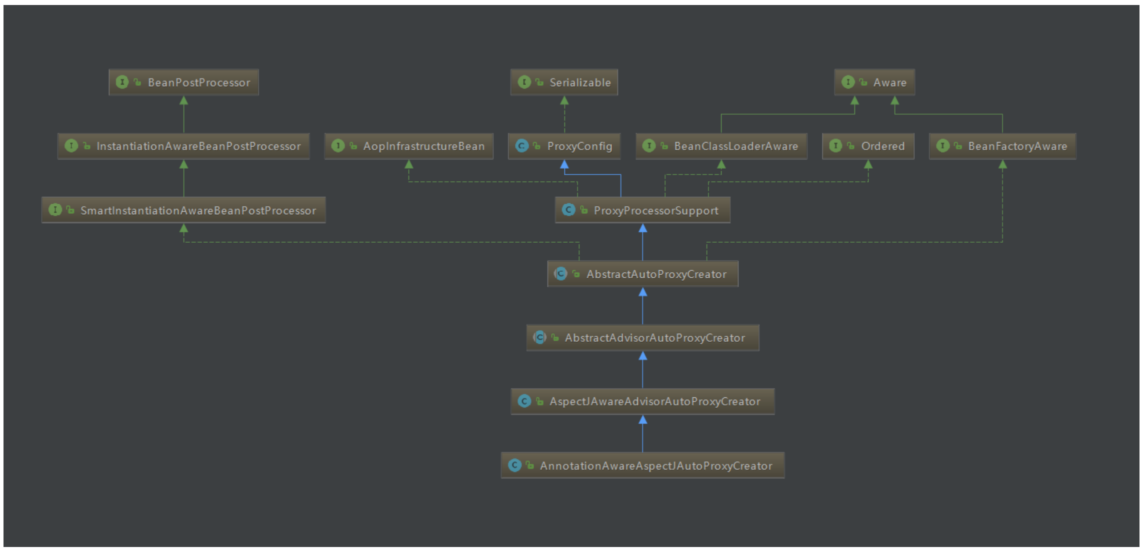
作用:往容器中注册了一个名称叫org.springframework.aop.config.internalAutoProxyCreator

　　类型为AnnotationAwareAspectJAutoProxyCreator **注解的**apsectj**自动代理创建器**

```
class AspectJAutoProxyRegistrar implements ImportBeanDefinitionRegistrar {

    @Override
    public void registerBeanDefinitions(AnnotationMetadata importingClassMetadata, BeanDefinitionRegistry registry) {

    //往容器中注册对应的 aspectj注解自动代理创建器
        AopConfigUtils.registerAspectJAnnotationAutoProxyCreatorIfNecessary(registry);

        AnnotationAttributes enableAspectJAutoProxy =
                AnnotationConfigUtils.attributesFor(importingClassMetadata, EnableAspectJAutoProxy.class);
        if (enableAspectJAutoProxy.getBoolean("proxyTargetClass")) {
            AopConfigUtils.forceAutoProxyCreatorToUseClassProxying(registry);
        }
        if (enableAspectJAutoProxy.getBoolean("exposeProxy")) {
            AopConfigUtils.forceAutoProxyCreatorToExposeProxy(registry);
        }
    }

}

=====================AopConfigUtils.registerAspectJAnnotationAutoProxyCreatorIfNecessary(registry);===
    public static BeanDefinition registerAspectJAnnotationAutoProxyCreatorIfNecessary(BeanDefinitionRegistry registry)
        return registerAspectJAnnotationAutoProxyCreatorIfNecessary(registry, null);
    }

    //注册一个AnnotationAwareAspectJAutoProxyCreator（注解适配的切面自动创建器）
    public static BeanDefinition registerAspectJAnnotationAutoProxyCreatorIfNecessary(BeanDefinitionRegistry registry,
        return registerOrEscalateApcAsRequired(AnnotationAwareAspectJAutoProxyCreator.class, registry, source);
    }

    private static BeanDefinition registerOrEscalateApcAsRequired(Class<?> cls, BeanDefinitionRegistry registry, Object
        Assert.notNull(registry, "BeanDefinitionRegistry must not be null");

    //判断容器中有没有org.springframework.aop.config.internalAutoProxyCreator 名称的bean定义
        if (registry.containsBeanDefinition(AUTO_PROXY_CREATOR_BEAN_NAME)) {
            BeanDefinition apcDefinition = registry.getBeanDefinition(AUTO_PROXY_CREATOR_BEAN_NAME);
            if (!cls.getName().equals(apcDefinition.getBeanClassName())) {
```

```
                        int currentPriority = findPriorityForClass(apcDefinition.getBeanClassName());
                        int requiredPriority = findPriorityForClass(cls);
                        if (currentPriority < requiredPriority) {
                            apcDefinition.setBeanClassName(cls.getName());
                        }
                    }
                    return null;
                }

        //容器中没有 那么就注册一个名称叫org.springframework.aop.config.internalAutoProxyCreator  类型是AnnotationAware
            RootBeanDefinition beanDefinition = new RootBeanDefinition(cls);
            beanDefinition.setSource(source);
            beanDefinition.getPropertyValues().add("order", Ordered.HIGHEST_PRECEDENCE);
            beanDefinition.setRole(BeanDefinition.ROLE_INFRASTRUCTURE);
            registry.registerBeanDefinition(AUTO_PROXY_CREATOR_BEAN_NAME, beanDefinition);
            return beanDefinition;
        }
```

3）所以我们现在可以分析一下AnnotationAwareAspectJAutoProxyCreator 他是什么一个鬼?


BeanPostProcessor
Serializable
Aware
InstantiationAwareBeanPostProcessor
AopInfrastructureBean
ProxyConfig
BeanClassLoaderAware
Ordered
BeanFactoryAware
SmartInstantiationAwareBeanPostProcessor
ProxyProcessorSupport
AbstractAutoProxyCreator
AbstractAdvisorAutoProxyCreator
AspectJAwareAdvisorAutoProxyCreator
AnnotationAwareAspectJAutoProxyCreator

根据上诉类图

1)我们发现了AnnotationAwareAspectJAutoProxyCreator 有实现了*Aware接口的特性(BeanFactoryAware)**

2)还发现了AnnotationAwareAspectJAutoProxyCreator 实现了BeanPostProcessor接口（后置处理器的特性）

3)还发现了AnnotationAwareAspectJAutoProxyCreator 实现了InstantiationAwareBeanPostProcessor接口(后置处理器的一种,在实例化之前进行调用)

3）我们根据上AnnotationAwareAspectJAutoProxyCreator 的类的继承图来分析AnnotationAwareAspectJAutoProxyCreator 的功能

3.1)所以我们首先来分析AnnotationAwareAspectJAutoProxyCreator 实现了BeanFactoryAware接口 做了什么工作?

①:org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator **实现了**BeanFactoryAware

我们查看源码的时候发现AbstractAutoProxyCreator 的setBeanFactory（）方法啥都没有做，但是又被子类覆盖了

```
    @Override
    public void setBeanFactory(BeanFactory beanFactory) {
        this.beanFactory = beanFactory;
    }
```

②:AbstractAdvisorAutoProxyCreator**覆盖了**AbstractAutoProxyCreator.setBeanFactory()**方法**

做了二件事情

1:调用父类的super.setBeanFactory(beanFactory);

2：调用本来的initBeanFactory((ConfigurableListableBeanFactory) beanFactory);初始化bean工厂方法

但是本类的AbstractAdvisorAutoProxyCreator.initBeanFactory()又被子类覆盖了

```
    public void setBeanFactory(BeanFactory beanFactory) {
        //调用父类AbstractAutoProxyCreator.setBeanFactory()方法
        super.setBeanFactory(beanFactory);
        if (!(beanFactory instanceof ConfigurableListableBeanFactory)) {
            throw new IllegalArgumentException(
                    "AdvisorAutoProxyCreator requires a ConfigurableListableBeanFactory: " + beanFactory);
        }
        //初始化bean工程
        initBeanFactory((ConfigurableListableBeanFactory) beanFactory);
    }

    protected void initBeanFactory(ConfigurableListableBeanFactory beanFactory) {
        this.advisorRetrievalHelper = new BeanFactoryAdvisorRetrievalHelperAdapter(beanFactory);
    }
```

③:AnnotationAwareAspectJAutoProxyCreator#initBeanFactory**覆盖了**AbstractAdvisorAutoProxyCreator.initBeanFactory()**方法**

```
    //创建一个aop的增强器通过@Apsectj注解的方式.
    protected void initBeanFactory(ConfigurableListableBeanFactory beanFactory) {
        //调用父类的
        super.initBeanFactory(beanFactory);
        //若 apsectj的增强器工厂对象为空,我们就创建一个ReflectiveAspectJAdvisorFactory
        if (this.aspectJAdvisorFactory == null) {
            this.aspectJAdvisorFactory = new ReflectiveAspectJAdvisorFactory(beanFactory);
        }
        //不为空 我们就把aspectJAdvisorFactory 包装为BeanFactoryAspectJAdvisorsBuilderAdapter
        this.aspectJAdvisorsBuilder =
                new BeanFactoryAspectJAdvisorsBuilderAdapter(beanFactory, this.aspectJAdvisorFactory);
    }
```

总结：AnnotationAwareAspectJAutoProxyCreator **实现了**BeanFactoryAware **也是做了二个事情**

事情1:**把**Beanfactory **保存到**AnnotationAwareAspectJAutoProxyCreator **组件上**.

事情2: **为**AnnotationAwareAspectJAutoProxyCreator **的**aspectJAdvisorsBuilder aspect**增强器构建器赋值**

3.2)**还发现了**AnnotationAwareAspectJAutoProxyCreator **实现了**BeanPostProcessor**接口（后置处理器的特性）**

我们追根溯源 AbstractAutoProxyCreator类实现了BeanPostProcessor接口 所以我们分析BeanPostProcessor的二个方法

①:postProcessBeforeInitialization初始化之前的方法 貌似什么都没有干

```
public Object postProcessBeforeInitialization(Object bean, String beanName) {
	return bean;
}
```

②:postProcessAfterInitialization **这个方法很重要 很重要 很重要 很重要很重要 很重要很重要 很重要很重要 很重要 后面单独说(创建代理对象的逻辑)**

```
public Object postProcessAfterInitialization(Object bean, String beanName) throws BeansException {
	if (bean != null) {
		Object cacheKey = getCacheKey(bean.getClass(), beanName);
		if (!this.earlyProxyReferences.contains(cacheKey)) {
			//包装bean 真正的创建代理对象逻辑
			return wrapIfNecessary(bean, beanName, cacheKey);
		}
	}
	return bean;
}
```

3.3)**还发现了**AnnotationAwareAspectJAutoProxyCreator **实现了**InstantiationAwareBeanPostProcessor**接口(后置处理器的一种,在实例化之前进行调用)**

我们追根溯源 AbstractAutoProxyCreator**类实现了**SmartInstantiationAwareBeanPostProcessor**接口 所以我们分析**SmartInstantiationAwareBeanPostProcessor**的二个方法**

①postProcessBeforeInstantiation**方法**

```
public Object postProcessBeforeInstantiation(Class<?> beanClass, String beanName) throws BeansException {
		Object cacheKey = getCacheKey(beanClass, beanName);

	 // 判断TargetSource缓存中是否包含当前bean，如果不包含，则判断当前bean是否是已经被代理的bean，
	// 如果代理过，则不对当前传入的bean进行处理，如果没代理过，则判断当前bean是否为系统bean，或者是
	// 切面逻辑不会包含的bean，如果是，则将当前bean缓存到advisedBeans中，否则继续往下执行。
	// 经过这一步的处理之后，只有在TargetSource中没有进行缓存，并且应该被切面逻辑环绕，但是目前还未
	// 生成代理对象的bean才会通过此方法。

		if (beanName == null || !this.targetSourcedBeans.contains(beanName)) {

			if (this.advisedBeans.containsKey(cacheKey)) {
				return null;
			}
			//若是基础的class ||或者是否应该跳过  shouldSkip直接返回false
			if (isInfrastructureClass(beanClass) || shouldSkip(beanClass, beanName)) {
				//把cacheKey 存放在advisedBeans中
				this.advisedBeans.put(cacheKey, Boolean.FALSE);
				//返回null
				return null;
			}
		}

		// 获取封装当前bean的TargetSource对象，如果不存在，则直接退出当前方法，否则从TargetSource
	 // 中获取当前bean对象，并且判断是否需要将切面逻辑应用在当前bean上。
		if (beanName != null) {
			TargetSource targetSource = getCustomTargetSource(beanClass, beanName);
```

```
                if (targetSource != null) {
                        this.targetSourcedBeans.add(beanName);
                        //// 获取能够应用当前bean的切面逻辑
                        Object[] specificInterceptors = getAdvicesAndAdvisorsForBean(beanClass, beanName, targetSource);
                        //// 根据切面逻辑为当前bean生成代理对象
                        Object proxy = createProxy(beanClass, beanName, specificInterceptors, targetSource);
                        this.proxyTypes.put(cacheKey, proxy.getClass());
                        return proxy;
                }
        }

        return null;
}

==============================判断是不是基础的bean==================================
protected boolean isInfrastructureClass(Class<?> beanClass) {
    //是不是Advice PointCut  Advisor   AopInfrastructureBean  满足任意返回ture
        boolean retVal = Advice.class.isAssignableFrom(beanClass) ||
                        Pointcut.class.isAssignableFrom(beanClass) ||
                        Advisor.class.isAssignableFrom(beanClass) ||
                        AopInfrastructureBean.class.isAssignableFrom(beanClass);
        if (retVal && logger.isTraceEnabled()) {
                logger.trace("Did not attempt to auto-proxy infrastructure class [" + beanClass.getName() + "]");
        }
        return retVal;
}
```

②:postProcessAfterInstantiation**方法**

```
@Override
public boolean postProcessAfterInstantiation(Object bean, String beanName) {
        return true;
}
```

4)真正的创建代理对象从BeanPostProcessor处理器的后置方法开始

1:>org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#postProcessAfterInitialization

2:>org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#wrapIfNecessary **有必要的话进行包装**

3:>org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#getAdvicesAndAdvisorsForBean

4:>org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#findEligibleAdvisors

5:>org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#findAdvisorsThatCanApply

6:>org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#createProxy**创建代理对象**

**4.1)
1:>org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#postProcessAfterInitialization
源码分析**

```
public Object postProcessAfterInitialization(Object bean, String beanName) throws BeansException {
```

```
            if (bean != null) {
                //通过传入的class 和beanName生成缓存key
                Object cacheKey = getCacheKey(bean.getClass(), beanName);
                if (!this.earlyProxyReferences.contains(cacheKey)) {
                  //若当前bean合适被包装为代理bean就进行处理
                    return wrapIfNecessary(bean, beanName, cacheKey);
                }
            }
            return bean;
        }
```

4.2)2:>org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#wrapIfNecessary**源码分析**

```
        protected Object wrapIfNecessary(Object bean, String beanName, Object cacheKey) {
            //已经被处理过的 不进行下面的处理
            if (beanName != null && this.targetSourcedBeans.contains(beanName)) {
                return bean;
            }
            //不需要被增强的直接返回
            if (Boolean.FALSE.equals(this.advisedBeans.get(cacheKey))) {
                return bean;
            }
            //判断当前bean是不是基础类型的bean,或者指定类型的bean 不需要代理
            if (isInfrastructureClass(bean.getClass()) || shouldSkip(bean.getClass(), beanName)) {
                this.advisedBeans.put(cacheKey, Boolean.FALSE);
                return bean;
            }

            //获取通知或者增强器
            Object[] specificInterceptors = getAdvicesAndAdvisorsForBean(bean.getClass(), beanName, null);
            //获取的不为空，生成代理对象
            if (specificInterceptors != DO_NOT_PROXY) {
                this.advisedBeans.put(cacheKey, Boolean.TRUE);
                //创建代理对象
                Object proxy = createProxy(
                        bean.getClass(), beanName, specificInterceptors, new SingletonTargetSource(bean));
                this.proxyTypes.put(cacheKey, proxy.getClass());
                return proxy;
            }
        //加入advisedBeans集合中
            this.advisedBeans.put(cacheKey, Boolean.FALSE);
            return bean;
        }

    /**
     * 判断什么是基础的class
     * */
    protected boolean isInfrastructureClass(Class<?> beanClass) {
            //判断当前的class是不是 Pointcut Advisor   Advice  AopInfrastructureBean 只要有一个满足就返回true
            boolean retVal = Advice.class.isAssignableFrom(beanClass) ||
                    Pointcut.class.isAssignableFrom(beanClass) ||
                    Advisor.class.isAssignableFrom(beanClass) ||
                    AopInfrastructureBean.class.isAssignableFrom(beanClass);
            if (retVal && logger.isTraceEnabled()) {
                logger.trace("Did not attempt to auto-proxy infrastructure class [" + beanClass.getName() + "]");
            }
            return retVal;
    }
```

4.3:>org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#getAdvicesAndAdvisorsForBear
源码分析

```
//找到符合条件的增强器
@Override
protected Object[] getAdvicesAndAdvisorsForBean(Class<?> beanClass, String beanName, TargetSource targetSourc
	//查找符合条件的增强器
	List<Advisor> advisors = findEligibleAdvisors(beanClass, beanName);
	if (advisors.isEmpty()) {
		return DO_NOT_PROXY;
	}
	return advisors.toArray();
}
```

4.4)org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#findEligibleAdvisors

```
protected List<Advisor> findEligibleAdvisors(Class<?> beanClass, String beanName) {
	//找到候选的增强器
	List<Advisor> candidateAdvisors = findCandidateAdvisors();
	//从候选的中选出能用的增强器
	List<Advisor> eligibleAdvisors = findAdvisorsThatCanApply(candidateAdvisors, beanClass, beanName);
	extendAdvisors(eligibleAdvisors);
	if (!eligibleAdvisors.isEmpty()) {
		eligibleAdvisors = sortAdvisors(eligibleAdvisors);
	}
	return eligibleAdvisors;
}
```

4.5)org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#findCandidateAdvisors
从IOC容器中查找所有的增强器

```
protected List<Advisor> findCandidateAdvisors() {
  //调用父类获取增强器
	List<Advisor> advisors = super.findCandidateAdvisors();
	//解析 @Aspect 注解，并构建通知器
	advisors.addAll(this.aspectJAdvisorsBuilder.buildAspectJAdvisors());
	return advisors;
}


  ========================================super.findCandidateAdvisors();===============
public List<Advisor> findAdvisorBeans() {
	//先从缓存中获取增强器   cachedAdvisorBeanNames是advisor的名称
	String[] advisorNames = this.cachedAdvisorBeanNames;
	//缓存中没有获取到
	if (advisorNames == null) {
		//从IOC容器中获取增强器的名称
		advisorNames = BeanFactoryUtils.beanNamesForTypeIncludingAncestors(
				this.beanFactory, Advisor.class, true, false);
		//赋值给增强器缓存
		this.cachedAdvisorBeanNames = advisorNames;
	}
	//在IOC容器中没有获取到直接返回
	if (advisorNames.length == 0) {
```

```
                return new ArrayList<Advisor>();
            }

            List<Advisor> advisors = new ArrayList<Advisor>();
            //遍历所有的增强器
            for (String name : advisorNames) {
                if (isEligibleBean(name)) {
                    //忽略正在创建的增强器
                    if (this.beanFactory.isCurrentlyInCreation(name)) {
                        if (logger.isDebugEnabled()) {
                            logger.debug("Skipping currently created advisor '" + name + "'");
                        }
                    }
                    else {
                        try {
                           //通过getBean的形式创建增强器 //并且将bean 添加到advisors中
                            advisors.add(this.beanFactory.getBean(name, Advisor.class));
                        }
                        catch (BeanCreationException ex) {
                            Throwable rootCause = ex.getMostSpecificCause();
                            if (rootCause instanceof BeanCurrentlyInCreationException) {
                                BeanCreationException bce = (BeanCreationException) rootCause;
                                if (this.beanFactory.isCurrentlyInCreation(bce.getBeanName())) {
                                    if (logger.isDebugEnabled()) {
                                        logger.debug("Skipping advisor '" + name +
                                                "' with dependency on currently created bean: " + ex.getMessag
                                    }
                                    // Ignore: indicates a reference back to the bean we're trying to advise.
                                    // We want to find advisors other than the currently created bean itself.
                                    continue;
                                }
                            }
                            throw ex;
                        }
                    }
                }
            }
            return advisors;
        }
```

==aspectJAdvisorsBuilder.buildAspectJAdvisors()解
下面buildAspectJAdvisors这个方法为我们做了什么?
第一步:先从增强器缓存中获取增强器对象
  判断缓存中有没有增强器对象,有，那么直接从缓存中直接获取返回出去
  没有.....从容器中获取所有的beanName
  遍历上一步获取所有的beanName,通过beanName获取beanType
  根据beanType判断当前bean是否是一个的Aspect注解类，若不是则不做任何处理
  调用advisorFactory.getAdvisors获取通知器

```
        public List<Advisor> buildAspectJAdvisors() {
            //先从缓存中获取
            List<String> aspectNames = this.aspectBeanNames;
            //缓存中没有获取到
            if (aspectNames == null) {
                synchronized (this) {
                   //在尝试从缓存中获取一次
                    aspectNames = this.aspectBeanNames;
                    //还是没有获取到
                    if (aspectNames == null) {
                        //从容器中获取所有的bean的name
                List<Advisor> advisors = new LinkedList<Advisor>();
                aspectNames = new LinkedList<String>();
                String[] beanNames = BeanFactoryUtils.beanNamesForTypeIncludingAncestors(
                        this.beanFactory, Object.class, true, false);

                //遍历beanNames
                for (String beanName : beanNames) {
                    if (!isEligibleBean(beanName)) {
                        continue;
                    }
                    //根据beanName获取bean的类型
                    Class<?> beanType = this.beanFactory.getType(beanName);
                    if (beanType == null) {
                        continue;
                    }
                    //检查beanType是否包含Aspect
                    if (this.advisorFactory.isAspect(beanType)) {
                        aspectNames.add(beanName);
                        //创建一饿Aspect类的源信息对象
                        AspectMetadata amd = new AspectMetadata(beanType, beanName);
                        if (amd.getAjType().getPerClause().getKind() == PerClauseKind.SINGLETON) {
                            MetadataAwareAspectInstanceFactory factory =
                                    new BeanFactoryAspectInstanceFactory(this.beanFactory, beanName);
                            //从aspectj中获取通知器
                            List<Advisor> classAdvisors = this.advisorFactory.getAdvisors(factory);
                            if (this.beanFactory.isSingleton(beanName)) {
                                this.advisorsCache.put(beanName, classAdvisors);
                            }
                            else {
                                this.aspectFactoryCache.put(beanName, factory);
                            }
                            advisors.addAll(classAdvisors);
                        }
                        else {
                            // Per target or per this.
                            if (this.beanFactory.isSingleton(beanName)) {
                                throw new IllegalArgumentException("Bean with name '" + beanName +
                                        "' is a singleton, but aspect instantiation model is not singleton"
                            }
                            MetadataAwareAspectInstanceFactory factory =
                                    new PrototypeAspectInstanceFactory(this.beanFactory, beanName);
                            this.aspectFactoryCache.put(beanName, factory);
                            advisors.addAll(this.advisorFactory.getAdvisors(factory));
                        }
                    }
                }
                this.aspectBeanNames = aspectNames;
                return advisors;
            }
        }
    }

//返回空
    if (aspectNames.isEmpty()) {
        return Collections.emptyList();
    }
    //缓存中有增强器，我们从缓存中获取返回出去
    List<Advisor> advisors = new LinkedList<Advisor>();
    for (String aspectName : aspectNames) {
        List<Advisor> cachedAdvisors = this.advisorsCache.get(aspectName);
        if (cachedAdvisors != null) {
            advisors.addAll(cachedAdvisors);
				}
				else {
					MetadataAwareAspectInstanceFactory factory = this.aspectFactoryCache.get(aspectName);
					advisors.addAll(this.advisorFactory.getAdvisors(factory));
				}
			}
			return advisors;
		}


//获取通知
===========org.springframework.aop.aspectj.annotation.AspectJAdvisorFactory#getAdvisors========
/**
 *
 *
 * */

		public List<Advisor> getAdvisors(MetadataAwareAspectInstanceFactory aspectInstanceFactory) {
			//获取标识了@AspectJ标志的切面类
			Class<?> aspectClass = aspectInstanceFactory.getAspectMetadata().getAspectClass();
			//获取切面的名称
			String aspectName = aspectInstanceFactory.getAspectMetadata().getAspectName();
			validate(aspectClass);

			// We need to wrap the MetadataAwareAspectInstanceFactory with a decorator
			// so that it will only instantiate once.
			MetadataAwareAspectInstanceFactory lazySingletonAspectInstanceFactory =
					new LazySingletonAspectInstanceFactoryDecorator(aspectInstanceFactory);

			List<Advisor> advisors = new ArrayList<Advisor>();
			//获取切面类排除@PointCut标志的所有方法
			for (Method method : getAdvisorMethods(aspectClass)) {
				//每一个方法都调用getAdvisor方法来获取增强器
				Advisor advisor = getAdvisor(method, lazySingletonAspectInstanceFactory, advisors.size(), aspectName);
				if (advisor != null) {
					advisors.add(advisor);
				}
			}

			// If it's a per target aspect, emit the dummy instantiating aspect.
			if (!advisors.isEmpty() && lazySingletonAspectInstanceFactory.getAspectMetadata().isLazilyInstantiated()) {
				Advisor instantiationAdvisor = new SyntheticInstantiationAdvisor(lazySingletonAspectInstanceFactory);
				advisors.add(0, instantiationAdvisor);
			}

			// Find introduction fields.
			for (Field field : aspectClass.getDeclaredFields()) {
				Advisor advisor = getDeclareParentsAdvisor(field);
				if (advisor != null) {
					advisors.add(advisor);
				}
			}

			return advisors;
		}


//通过方法获取增强器
public Advisor getAdvisor(Method candidateAdviceMethod, MetadataAwareAspectInstanceFactory aspectInstanceFactory,
				int declarationOrderInAspect, String aspectName) {

			validate(aspectInstanceFactory.getAspectMetadata().getAspectClass());
```

```
        //获取aspectj的切点表达式
                AspectJExpressionPointcut expressionPointcut = getPointcut(
                                candidateAdviceMethod, aspectInstanceFactory.getAspectMetadata().getAspectClass());
                if (expressionPointcut == null) {
                        return null;
                }

        //创建advisor实现类
                return new InstantiationModelAwarePointcutAdvisorImpl(expressionPointcut, candidateAdviceMethod,
                                this, aspectInstanceFactory, declarationOrderInAspect, aspectName);
}

//获取切点表达式
private AspectJExpressionPointcut getPointcut(Method candidateAdviceMethod, Class<?> candidateAspectClass) {
                //获取切面注解 @Before   @After。。。。。。
                AspectJAnnotation<?> aspectJAnnotation =
                                AbstractAspectJAdvisorFactory.findAspectJAnnotationOnMethod(candidateAdviceMethod);
                if (aspectJAnnotation == null) {
                        return null;
                }

        //获取切点表达式对象
                AspectJExpressionPointcut ajexp =
                                new AspectJExpressionPointcut(candidateAspectClass, new String[0], new Class<?>[0]);
                //设置切点表达式
                ajexp.setExpression(aspectJAnnotation.getPointcutExpression());
                ajexp.setBeanFactory(this.beanFactory);
                return ajexp;
        }

//找到切面类中方法上的切面注解
protected static AspectJAnnotation<?> findAspectJAnnotationOnMethod(Method method) {
        //Pointcut.class, Around.class, Before.class, After.class, AfterReturning.class, AfterThrowing.class
                for (Class<?> clazz : ASPECTJ_ANNOTATION_CLASSES) {
                        AspectJAnnotation<?> foundAnnotation = findAnnotation(method, (Class<Annotation>) clazz);
                        if (foundAnnotation != null) {
                                return foundAnnotation;
                        }
                }
                return null;
        }

//把切点，候选的方法....统一处理生成一个增强器
public InstantiationModelAwarePointcutAdvisorImpl(AspectJExpressionPointcut declaredPointcut,
                        Method aspectJAdviceMethod, AspectJAdvisorFactory aspectJAdvisorFactory,
                        MetadataAwareAspectInstanceFactory aspectInstanceFactory, int declarationOrder, String aspectName) {

                this.declaredPointcut = declaredPointcut;
                this.declaringClass = aspectJAdviceMethod.getDeclaringClass();
                this.methodName = aspectJAdviceMethod.getName();
                this.parameterTypes = aspectJAdviceMethod.getParameterTypes();
                this.aspectJAdviceMethod = aspectJAdviceMethod;
                this.aspectJAdvisorFactory = aspectJAdvisorFactory;
                this.aspectInstanceFactory = aspectInstanceFactory;
                this.declarationOrder = declarationOrder;
                this.aspectName = aspectName;

                if (aspectInstanceFactory.getAspectMetadata().isLazilyInstantiated()) {
                        // Static part of the pointcut is a lazy type.
                        Pointcut preInstantiationPointcut = Pointcuts.union(
                                        aspectInstanceFactory.getAspectMetadata().getPerClausePointcut(), this.declaredPointcut);
```

```
			// Make it dynamic: must mutate from pre-instantiation to post-instantiation state.
			// If it's not a dynamic pointcut, it may be optimized out
			// by the Spring AOP infrastructure after the first evaluation.
			this.pointcut = new PerTargetInstantiationModelPointcut(
					this.declaredPointcut, preInstantiationPointcut, aspectInstanceFactory);
			this.lazy = true;
		}
		else {
			// A singleton aspect.
			this.pointcut = this.declaredPointcut;
			this.lazy = false;
			//实例化切面
			this.instantiatedAdvice = instantiateAdvice(this.declaredPointcut);
		}
	}

//获取advice 切面对象
public Advice getAdvice(Method candidateAdviceMethod, AspectJExpressionPointcut expressionPointcut,
			MetadataAwareAspectInstanceFactory aspectInstanceFactory, int declarationOrder, String aspectName) {

	//获取候选的切面类
		Class<?> candidateAspectClass = aspectInstanceFactory.getAspectMetadata().getAspectClass();
		validate(candidateAspectClass);

	//获取切面注解
		AspectJAnnotation<?> aspectJAnnotation =
				AbstractAspectJAdvisorFactory.findAspectJAnnotationOnMethod(candidateAdviceMethod);
		if (aspectJAnnotation == null) {
			return null;
		}

		// If we get here, we know we have an AspectJ method.
		// Check that it's an AspectJ-annotated class
		if (!isAspect(candidateAspectClass)) {
			throw new AopConfigException("Advice must be declared inside an aspect type: " +
					"Offending method '" + candidateAdviceMethod + "' in class [" +
					candidateAspectClass.getName() + "]");
		}

		if (logger.isDebugEnabled()) {
			logger.debug("Found AspectJ method: " + candidateAdviceMethod);
		}

		AbstractAspectJAdvice springAdvice;

	//判断注解的类型
		switch (aspectJAnnotation.getAnnotationType()) {
			//是切点的返回null
			case AtPointcut:
				if (logger.isDebugEnabled()) {
					logger.debug("Processing pointcut '" + candidateAdviceMethod.getName() + "'");
				}
				return null;
			//是不是环绕通知
			case AtAround:
				springAdvice = new AspectJAroundAdvice(
						candidateAdviceMethod, expressionPointcut, aspectInstanceFactory);
				break;
			//是不是前置通知
			case AtBefore:
				springAdvice = new AspectJMethodBeforeAdvice(
                                candidateAdviceMethod, expressionPointcut, aspectInstanceFactory);
                        break;
                //是不是后置通知
                case AtAfter:
                        springAdvice = new AspectJAfterAdvice(
                                candidateAdviceMethod, expressionPointcut, aspectInstanceFactory);
                        break;
                //返回通知
                case AtAfterReturning:
                        springAdvice = new AspectJAfterReturningAdvice(
                                candidateAdviceMethod, expressionPointcut, aspectInstanceFactory);
                        AfterReturning afterReturningAnnotation = (AfterReturning) aspectJAnnotation.getAnnotation();
                        if (StringUtils.hasText(afterReturningAnnotation.returning())) {
                                springAdvice.setReturningName(afterReturningAnnotation.returning());
                        }
                        break;
                是不是异常通知
                case AtAfterThrowing:
                        springAdvice = new AspectJAfterThrowingAdvice(
                                candidateAdviceMethod, expressionPointcut, aspectInstanceFactory);
                        AfterThrowing afterThrowingAnnotation = (AfterThrowing) aspectJAnnotation.getAnnotation();
                        if (StringUtils.hasText(afterThrowingAnnotation.throwing())) {
                                springAdvice.setThrowingName(afterThrowingAnnotation.throwing());
                        }
                        break;
                default:
                        throw new UnsupportedOperationException(
                                "Unsupported advice type on method: " + candidateAdviceMethod);
        }

        // Now to configure the advice...
        springAdvice.setAspectName(aspectName);
        springAdvice.setDeclarationOrder(declarationOrder);
   /*
    * 获取方法的参数列表名称，比如方法 int sum(int numX, int numY),
    * getParameterNames(sum) 得到 argNames = [numX, numY]
    */
        String[] argNames = this.parameterNameDiscoverer.getParameterNames(candidateAdviceMethod);
        if (argNames != null) {
          //为切面设置参数
                springAdvice.setArgumentNamesFromStringArray(argNames);
        }
        springAdvice.calculateArgumentBindings();

        return springAdvice;
}
```

4.6:)>org.springframework.aop.framework.autoproxy.AbstractAdvisorAutoProxyCreator#findAdvisorsThatCanApply

```
//获取能够使用的增强器
protected List<Advisor> findAdvisorsThatCanApply(
                List<Advisor> candidateAdvisors, Class<?> beanClass, String beanName) {
```

```
		ProxyCreationContext.setCurrentProxiedBeanName(beanName);
		try {
			return AopUtils.findAdvisorsThatCanApply(candidateAdvisors, beanClass);
		}
		finally {
			ProxyCreationContext.setCurrentProxiedBeanName(null);
		}
	}

 //获取能使用的增强器
	public static List<Advisor> findAdvisorsThatCanApply(List<Advisor> candidateAdvisors, Class<?> clazz) {
		if (candidateAdvisors.isEmpty()) {
			return candidateAdvisors;
		}
		List<Advisor> eligibleAdvisors = new LinkedList<Advisor>();
		//遍历候选的增强器 把他增加到eligibleAdvisors集合中返回
		for (Advisor candidate : candidateAdvisors) {
			if (candidate instanceof IntroductionAdvisor && canApply(candidate, clazz)) {
				eligibleAdvisors.add(candidate);
			}
		}
		boolean hasIntroductions = !eligibleAdvisors.isEmpty();
		for (Advisor candidate : candidateAdvisors) {
			if (candidate instanceof IntroductionAdvisor) {
				// already processed
				continue;
			}
			if (canApply(candidate, clazz, hasIntroductions)) {
				eligibleAdvisors.add(candidate);
			}
		}
		return eligibleAdvisors;
	}

	//判断是当前的增强器是否能用 通过方法匹配来计算当前是否合适当前类的增强器
	public static boolean canApply(Advisor advisor, Class<?> targetClass, boolean hasIntroductions) {
		if (advisor instanceof IntroductionAdvisor) {
			return ((IntroductionAdvisor) advisor).getClassFilter().matches(targetClass);
		}
		else if (advisor instanceof PointcutAdvisor) {
			PointcutAdvisor pca = (PointcutAdvisor) advisor;
			return canApply(pca.getPointcut(), targetClass, hasIntroductions);
		}
		else {
			// It doesn't have a pointcut so we assume it applies.
			return true;
		}
	}



	public static boolean canApply(Pointcut pc, Class<?> targetClass, boolean hasIntroductions) {
		Assert.notNull(pc, "Pointcut must not be null");
		if (!pc.getClassFilter().matches(targetClass)) {
			return false;
		}

	//创建一个方法匹配器
		MethodMatcher methodMatcher = pc.getMethodMatcher();
		if (methodMatcher == MethodMatcher.TRUE) {
			// No need to iterate the methods if we're matching any method anyway...
			return true;
```

```
        }

    //包装方法匹配器
        IntroductionAwareMethodMatcher introductionAwareMethodMatcher = null;
        if (methodMatcher instanceof IntroductionAwareMethodMatcher) {
            introductionAwareMethodMatcher = (IntroductionAwareMethodMatcher) methodMatcher;
        }

    //获取本来和接口
        Set<Class<?>> classes = new LinkedHashSet<Class<?>>(ClassUtils.getAllInterfacesForClassAsSet(targetClass)
        classes.add(targetClass);
        //循环classes
        for (Class<?> clazz : classes) {
          //获取所有的方法 进行匹配
            Method[] methods = ReflectionUtils.getAllDeclaredMethods(clazz);
            for (Method method : methods) {
                if ((introductionAwareMethodMatcher != null &&
                        introductionAwareMethodMatcher.matches(method, targetClass, hasIntroductions)) ||
                        methodMatcher.matches(method, targetClass)) {
                    return true;
                }
            }
        }

        return false;
    }
```

4.5)org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#createProxy**创建代理对象**

```
    protected Object createProxy(
            Class<?> beanClass, String beanName, Object[] specificInterceptors, TargetSource targetSource) {

    //判断容器的类型ConfigurableListableBeanFactory
        if (this.beanFactory instanceof ConfigurableListableBeanFactory) {
            AutoProxyUtils.exposeTargetClass((ConfigurableListableBeanFactory) this.beanFactory, beanName, beanCl
        }

    //创建代理工程
        ProxyFactory proxyFactory = new ProxyFactory();
        proxyFactory.copyFrom(this);


    /*
     * 默认配置下，或用户显式配置 proxy-target-class = "false" 时，
     * 这里的 proxyFactory.isProxyTargetClass() 也为 false
     */
        if (!proxyFactory.isProxyTargetClass()) {
            if (shouldProxyTargetClass(beanClass, beanName)) {
                proxyFactory.setProxyTargetClass(true);
            }

            else {
              /*
         * 检测 beanClass 是否实现了接口，若未实现，则将
         * proxyFactory 的成员变量 proxyTargetClass 设为 true
         */
                evaluateProxyInterfaces(beanClass, proxyFactory);
            }
        }

    //获取容器中的方法增强器
```

```
        Advisor[] advisors = buildAdvisors(beanName, specificInterceptors);
        proxyFactory.addAdvisors(advisors);
        proxyFactory.setTargetSource(targetSource);
        customizeProxyFactory(proxyFactory);

        proxyFactory.setFrozen(this.freezeProxy);
        if (advisorsPreFiltered()) {
            proxyFactory.setPreFiltered(true);
        }

    //创建代理对象
        return proxyFactory.getProxy(getProxyClassLoader());
    }

    public Object getProxy(ClassLoader classLoader) {
        return createAopProxy().getProxy(classLoader);
    }

    public AopProxy createAopProxy(AdvisedSupport config) throws AopConfigException {
        if (config.isOptimize() || config.isProxyTargetClass() || hasNoUserSuppliedProxyInterfaces(config)) {
            Class<?> targetClass = config.getTargetClass();
            if (targetClass == null) {
                throw new AopConfigException("TargetSource cannot determine target class: " +
                        "Either an interface or a target is required for proxy creation.");
            }
            //是否实现了接口
            if (targetClass.isInterface() || Proxy.isProxyClass(targetClass)) {
              //jdk代理
                return new JdkDynamicAopProxy(config);
            }
            //cglib代理
            return new ObjenesisCglibAopProxy(config);
        }
        else {
          jdk代理
            return new JdkDynamicAopProxy(config);
        }
    }

    public Object getProxy(ClassLoader classLoader) {
        if (logger.isDebugEnabled()) {
            logger.debug("Creating JDK dynamic proxy: target source is " + this.advised.getTargetSource());
        }
        Class<?>[] proxiedInterfaces = AopProxyUtils.completeProxiedInterfaces(this.advised, true);
        findDefinedEqualsAndHashCodeMethods(proxiedInterfaces);
        //创建jdk代理对象
        return Proxy.newProxyInstance(classLoader, proxiedInterfaces, this);
    }
```

5：**代理对象调用目标方法**

背景知识:

@EnableAspectJAutoProxy(exposeProxy = true) **这个东东是用来干什么的?**

没有配置exposeProxy **暴露代理对象的时候我们方法调用**

我们在Mod**方法中 通过**this**来调用本类的方法**add()**方法的时候，发现**add()**的方法不会被拦截**

而我们配置了后exposeProxy**的属性，我们发现可以通过**

int retVal = ((Calculate) AopContext.currentProxy()).add(numA,numB);

调用的时候，发现了add()**方法可以被拦截**

原理:**把这个**exposeProxy**设置为**true，**会把代理对象存放在线程变量中**,

AopContext.currentProxy())**是从线程变量中获取代理对象（源码中分析）**

应用场景(**事物方法调用事物方法需要二个都起作用需要配置这个东东**)

```
public interface Calculate {

    /**
     * 加法
     * @param numA
     * @param numB
     * @return
     */
     int add(int numA,int numB);

    /**
     * 减法
     * @param numA
     * @param numB
     * @return
     */
     int reduce(int numA,int numB);

    /**
     * 除法
     * @param numA
     * @param numB
     * @return
     */
     int div(int numA,int numB);

    /**
     * 乘法
     * @param numA
     * @param numB
     * @return
     */
     int multi(int numA,int numB);

     int mod(int numA,int numB);
}

public class TulingCalculate implements Calculate {

    public int add(int numA, int numB) {

        return numA+numB;
    }

    public int reduce(int numA, int numB) {
        return numA-numB;
    }

    public int div(int numA, int numB) {
        return numA/numB;
    }

    public int multi(int numA, int numB) {
        return numA*numB;
    }

    public int mod(int numA,int numB){
        int retVal = ((Calculate) AopContext.currentProxy()).add(numA,numB);

        //int retVal = this.add(numA,numB);
        return retVal%numA;
    }
}
```

代理对象调用源代码:

```
        public Object invoke(Object proxy, Method method, Object[] args) throws Throwable {
                MethodInvocation invocation;
                Object oldProxy = null;
                boolean setProxyContext = false;

                TargetSource targetSource = this.advised.targetSource;
                Class<?> targetClass = null;
                Object target = null;

                try {

                        Object retVal;

            //是否暴露代理对象
                        if (this.advised.exposeProxy) {
                                //把代理对象添加到TheadLocal中
                                oldProxy = AopContext.setCurrentProxy(proxy);
                                setProxyContext = true;
                        }

            //获取被代理对象
                        target = targetSource.getTarget();
                        if (target != null) {
                            //设置被代理对象的class
                                targetClass = target.getClass();
                        }

                        //把增强器转为方法拦截器链
                        List<Object> chain = this.advised.getInterceptorsAndDynamicInterceptionAdvice(method, targetClass);

                    //若方法拦截器链为空
                        if (chain.isEmpty()) {
                //通过反射直接调用目标方法
                                Object[] argsToUse = AopProxyUtils.adaptArgumentsIfNecessary(method, args);
                                retVal = AopUtils.invokeJoinpointUsingReflection(target, method, argsToUse);
                        }
                        else {
                                //创建方法拦截器调用链条
                    invocation = new ReflectiveMethodInvocation(proxy, target, method, args, targetClass, chain);
                    //执行拦截器链
                    retVal = invocation.proceed();
                }

                //获取方法的返回值类型
                Class<?> returnType = method.getReturnType();
                if (retVal != null && retVal == target &&
                        returnType != Object.class && returnType.isInstance(proxy) &&
                        !RawTargetAccess.class.isAssignableFrom(method.getDeclaringClass())) {
                    //如果方法返回值为 this，即 return this; 则将代理对象 proxy 赋值给 retVal
                    retVal = proxy;
                }
                //如果返回值类型为基础类型，比如 int，long 等，当返回值为 null，抛出异常
                else if (retVal == null && returnType != Void.TYPE && returnType.isPrimitive()) {
                    throw new AopInvocationException(
                            "Null return value from advice does not match primitive return type for: " + method);
                }
                return retVal;
            }
            finally {
                if (target != null && !targetSource.isStatic()) {
                    // Must have come from TargetSource.
                    targetSource.releaseTarget(target);
                }
                if (setProxyContext) {
                    // Restore old proxy.
                    AopContext.setCurrentProxy(oldProxy);
                }
            }
        }

====================org.springframework.aop.framework.AdvisedSupport#getInterceptorsAndDynamicInter
把增强器中转为方法拦截器链
        public List<Object> getInterceptorsAndDynamicInterceptionAdvice(Method method, Class<?> targetClass) {
            //从缓存中获取缓存key 第一次肯定获取不到
            MethodCacheKey cacheKey = new MethodCacheKey(method);
            //通过cacheKey获取缓存值
            List<Object> cached = this.methodCache.get(cacheKey);

            //从缓存中没有获取到
            if (cached == null) {
              //获取所有的拦截器
                cached = this.advisorChainFactory.getInterceptorsAndDynamicInterceptionAdvice(
                        this, method, targetClass);
              //放入缓存.....
                this.methodCache.put(cacheKey, cached);
            }
            return cached;
        }

====================org.springframework.aop.framework.AdvisorChainFactory#getInterceptorsAndDynamic
        public List<Object> getInterceptorsAndDynamicInterceptionAdvice(
                Advised config, Method method, Class<?> targetClass) {

          //创建拦截器集合长度是增强器的长度
            List<Object> interceptorList = new ArrayList<Object>(config.getAdvisors().length);

            Class<?> actualClass = (targetClass != null ? targetClass : method.getDeclaringClass());
            boolean hasIntroductions = hasMatchingIntroductions(config, actualClass);
            AdvisorAdapterRegistry registry = GlobalAdvisorAdapterRegistry.getInstance();
```

```
//遍历所有的增强器集合
        for (Advisor advisor : config.getAdvisors()) {
                //判断增强器是不是PointcutAdvisor
                if (advisor instanceof PointcutAdvisor) {
                        //把增强器转为PointcutAdvisor
                        PointcutAdvisor pointcutAdvisor = (PointcutAdvisor) advisor;
                        //通过方法匹配器对增强器进行匹配
                        if (config.isPreFiltered() || pointcutAdvisor.getPointcut().getClassFilter().matches(actualClass)) {
                                MethodMatcher mm = pointcutAdvisor.getPointcut().getMethodMatcher();
                                //能够匹配
                                if (MethodMatchers.matches(mm, method, actualClass, hasIntroductions)) {
                                        //把增强器转为拦截器
                                        MethodInterceptor[] interceptors = registry.getInterceptors(advisor);
                                        if (mm.isRuntime()) {
                                                // Creating a new object instance in the getInterceptors() method
                                                // isn't a problem as we normally cache created chains.
                                                for (MethodInterceptor interceptor : interceptors) {
                                                        interceptorList.add(new InterceptorAndDynamicMethodMatcher(interceptor, mm
                                                }
                                        }
                                        else {
                                                interceptorList.addAll(Arrays.asList(interceptors));
                                        }
                                }
                        }
                }
                else if (advisor instanceof IntroductionAdvisor) {
                        IntroductionAdvisor ia = (IntroductionAdvisor) advisor;
                        if (config.isPreFiltered() || ia.getClassFilter().matches(actualClass)) {
                                Interceptor[] interceptors = registry.getInterceptors(advisor);
                                interceptorList.addAll(Arrays.asList(interceptors));
                        }
                }
                else {
                        Interceptor[] interceptors = registry.getInterceptors(advisor);
                        interceptorList.addAll(Arrays.asList(interceptors));
                }
        }

        return interceptorList;
}
```